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Nonlinear Programming Solution of Optimal Control Processes

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The results obtained under this grant are described in two recent reports. The first of these titled "Optimal Control and Convex Programming" was issued in February. In this report a general type of discrete optimal control problem with both control and state constraints is considered. Necessary conditions for a relative minimum are given (assuming only differentiability) based on the Kuhn-Tucker theory. For a convex function and linear system of differential equations it is shown that these conditions are also sufficient for a global minimum. A computational scheme is described for the state constrained problem where the conditions are sufficient. The scheme is based on a convex programming method and determines first if any admissible control exists, and if so, finds an optimal control. The solution of a four-dimensional system with state constraints is presented in order to illustrate this computational scheme.

The second report was just issued (July) and is titled "Iterative Solution of Nonlinear Optimal Control Problems." In this report the solution of nonlinear, state-constrained, discrete optimal control problems by mathematical programming methods is described. The iterative solution consists essentially of Newton's method with a convex (or linear) programming problem solved at each iteration. Global convergence of the iterative method is demonstrated provided a convexity and constraint set condition are both satisfied. The computational solution of nonlinear equation control problems makes use of the previously developed method for state-constrained linear equation problems. The solution method for nonlinear problems is illustrated by means of two numerical examples.

Copies of these reports are being sent to the NASA Office of Grants and Research Contracts.